6-703.11 1127

FERNALD CLEANUP PROGRESS BRIEFING
DECEMBER 1997

6:00	Welcome	Gary Stegner, DOE
6:05	Background on Fernald Materials Recycling Initiatives	Pete Yerace, DOE
6:10	Material Release	Andy Rogers, Fluor Daniel Fernald
6:25	Authorized Release of Fernald Copper Ingots	Neal Frink, Trinity Environmental Systems
7:15	Stakeholder Feedback	Pete Yerace, DOE
7:30	Introduction	Nina Akgunduz, DOE
7:35	Silos Project Public Involvement Path Forward	Terry Hagen, Fluor Daniel Fernald
7:45	Silos 1 and 2 Proof of Principle Testing	Dennis Nixon Fluor Daniel Fernald
8:30	Meeting Adjourns	

4847.A1 12/97

FERNALD CLEANUP PROGRESS BRIEFING

Evaluation

December 9, 1997

Thank you for attending the December Cleanup Progress Briefing. Your feedback is important to us. Please take a minute to complete this evaluation.

1. **Please check the most appropriate response:**
   This is the first Cleanup Progress Briefing I have attended. ____
   I regularly attend monthly Cleanup Progress Briefings, when my schedule permits. ____
   At this time, I do not plan to attend future Cleanup Progress Briefings. ____

2. **The presentations on authorized release of Fernald materials and the Silos Project were: (Please check all that apply.)**
   understandable ________
   good balance of information and detail ________
   too detailed ________
   more information needed on the following subjects:

3. **Were questions adequately addressed during the meeting?**
   Yes ________
   No ________ Please explain.

4. **Do you use the Cleanup Progress Briefing "Tool Box" to organize information?**
   Yes _____
   No _____
   I do not have a Tool Box, but would like one provided to me. _____
   Comments:

5. **Please indicate potential topics for future Cleanup Progress Briefings "Topic of the Month".**

6. **How did you hear about the meeting(s)?** Please check all that apply.
   ____ Postcard in the mail
   ____ *Fernald Report*
   ____ *A Look Ahead* publication
   ____ Internet: Fernald Web site (www.fernald.gov)
   ____ Fernald Envoy
   ____ Other (please indicate)

7. **Do you have any other comments or suggestions about tonight's meeting?**

Optional:
Name________________________________ Phone______________

If you did not receive a postcard on the meeting tonight, then you may not be on Fernald's Community Mailing List to receive cleanup news, meeting invitations and document review notices. If you would like to be on the mailing list, please complete the information below.

Public Affairs Mailing List Addition Request

To be added to the Public Affairs mailing list, please complete this form. If the question does not apply to you, please write "n/a".

Please spell out all names -- do not use initials.

Title Mr Mrs Miss Ms Dr **First Name** ______________ **Last Name** ______________

Organization ______________________ **Job Title** ______________________

1st Address Line ______________________ ***2nd Address Line** ______________

City ______________ **State** ______ **Zip** ________

Home Phone ______________ **Work Phone** ______________ **Fax** ______________

Township ______________ **County** ______________

* The second address line is a continuation of an address for example:

Bob Smith
444 W. 3rd St.
Room 3134
Anywhere, USA 12345

FERNALD
Environmental Management Project

December 1997

COPPER INGOT DISPOSITION ALTERNATIVES

Overview

The Department of Energy (DOE) completed analyses to select a disposition alternative for 59 metric tons of copper ingots from the Fernald Environmental Management Project (FEMP).

A range of competing disposition methods was analyzed and two leading alternatives identified: 1) recycle at a copper refinery, and 2) the default option of disposal as low level waste. To allow unrestricted release for recycle, authorized limits were developed in accordance with DOE Order 5400.5 *Radiation Protection of the Public and the Environment* and the DOE *Handbook for Controlling Release for Reuse or Recycle of Property Containing Residual Radioactive Material*. To compare the recycle and disposal alternatives, the Draft Final *Decision Methodology for Fernald Material Disposition Alternatives* was utilized as the decision-making framework.

Results

Alternative 1, recycle at a copper refinery, complies with all regulatory requirements, is protective of human health, and is more cost effective than the disposal alternative. The recycle alternative dominated the disposal alternative when analyzed under the *Decision Methodology*, producing performance measures that were as good as, or better than, disposal in every case.

Background

During the mid-seventies 1,090 metric tons of scrap copper motor windings and electrical bus bar from the DOE gaseous diffusion plants were sent to the Fernald site for recycle. About 109 metric tons of this scrap was melt-refined in 1980 to produce "clean" copper ingots for reuse/recycle. Fifty metric tons of the copper were used to manufacture components for use at the DOE Hanford site. The remaining 59 metric tons remained in storage at Fernald pending development of release limits to address the slight amount of volumetric (mass) contamination.

Authorized Limits

Under DOE Order 5400.5, authorized limits may be developed on a case-by-case basis to provide standards for release of materials with volumetric contamination. In January 1997, DOE initiated an effort to develop release limits for the copper ingots using the most recent DOE guidance and state-of-the-art pathway analysis tools.

Some of the key steps in developing authorized limits and the results from the analysis are described below:

Characterization of the copper ingots.

The scrap copper was shredded, granulated, air separated from plastic and insulation, and finally melt-refined in vacuum induction furnaces in Plant 5. The resulting copper ingots cast from the process have the following physical attributes:

- approximately 270 ingots;
- 7-8" diameter x 30" high cylinders;
- average weight 480 pounds.

The copper ingots are considered high-grade scrap copper and based on minor chemical impurities would require refining prior to use in electrical applications.

The ingots average 4.25 pico-Curies per gram of uranium (1.6 ppm) which is within the range of natural uranium found in Ohio soils. If all of the uranium were removed from within the 59 metric tons of copper, it would amount to 353 grams (about ¾ of a pound).

Dose assessment to determine radiation exposures under release scenarios.

The dose assessment was completed using the RESRAD-RECYCLE pathway analysis computer model, which is designed specifically for scrap metal recycle. Exposures to workers and members of the general public were calculated for individual exposures during each step of the copper recycling process including transportation, refining, semi-fabrication, manufacturing, and end-product use.

Dose to the maximally exposed individual (MEI) and cumulative population doses were calculated for the "actual and likely" and "worst plausible" release scenarios. The highest modeled exposures were as follows:

Exposure	Individual Dose (mrem/yr)	Cumulative Dose (person-rem)
Scrap loader	0.0013	0.000002
Slag worker	0.0177	0.000018
Plumbing tube	0.0007	0.031
Frying pan	0.0005	0.011
Copper IUD	0.0001	0.043

The dose to the MEI is well below the 100-mrem annual dose limit specified in DOE Order 5400.5.

Cost analysis to determine the full life cycle cost of implementing a selected alternative.

The sale of 59 metric tons of copper ingots as copper scrap is estimated to generate nearly $60,000 in revenue for DOE compared with a cost for off-site disposal of about $40,000. This cost differential provides ample margin in the event some surface decontamination is required prior to release.

ALARA analysis to confirm that the alternative maintains radiation exposures as low as reasonably achievable.

ALARA analysis demonstrated that exposures were as low as reasonably achievable, with doses less than a few mrem per year for the MEI and cumulative population doses well below 10 person-rem.

Additional criteria that may influence selection of a disposition alternative.

Additional factors considered included schedule impacts, local economic impacts, institutional preferences, local social preferences, and environmental impacts. The recycle alternative was as good as, or better than, the disposal alternative for each of these performance measures.

Next Steps

Stakeholder Coordination – DOE will respond to any stakeholder issues or questions raised concerning the project.

Application for Authorized Limits – DOE will coordinate with regulators and obtain formal approval from the Ohio Field Office for implementation.

For More Information...

Call DOE Public Information Officer Gary Stegner at (513) 648-3153, or write to him at the following address:

Gary Stegner
U.S. Department of Energy
Fernald Environmental Management Project
P.O. Box 538705
Cincinnati, OH 45253-8705

Visit the Fernald Website at www.fernald.gov

Fernald Silos Project
Silos 1 & 2 Proof of Principle
Request for Proposal Briefing Package

Silos Project
Proof of Principle - RFP Briefing
Preliminary Screening of Technologies

Sources of Potential Technologies

- Literature search conducted for Silo 3 Explanation of Significant Differences.
- Technologies recommended for evaluation by the Independent Review Team.
- Expressions of Interest in response to the Silos 1 and 2 Proof of Principle CBD Announcement.

Silos Project
Proof of Principle - RFP Briefing
Preliminary Screening of Technologies

Technologies To Be Considered

TECHNOLOGY	SOURCE OF TECHNOLOGY		
	IRT	SILO 3 ESD	CBD
Joule-Heated Vitrification	X		X
Cyclone Vitrification			X
Rotary Vitrification			X
Plasma Arc Vitrification			X
Cement-based Chemical Stabilization	X	X	X
non-Cement-based Chemical Stabilization		X	X
Ceramic Encapsulation	X	X	X
Polymer Phosphate Stabilization			X
Polymer-Based Encapsulation	X	X	X
Thermal Stabilization	X	X	

Silos Project
Proof of Principle - RFP Briefing
Preliminary Screening of Technologies

Criteria

Effectiveness

- Mobility of Constituents of Concern (COCs)
- Increase/Decrease in Treated Waste Volume
- Attainment of TCLP limits for Characteristic Metals
- Long-term Effectiveness/Permanence

Implementability

- Degree of Commercial Implementation
- Generation of Secondary Waste Streams
- Pretreatment Requirements
- Processing Throughput
- System Reliability/Maintainability

Cost

SCREENING OF POTENTIAL TECHNOLOGIES - EFFECTIVENESS

STABILIZATION ALTERNATIVE	MOBILITY OF CONSTITUENTS OF CONCERN	INCREASE/ DECREASE in TREATED WASTE VOLUME[1] Does not consider shielding or packaging volume	ATTAINMENT OF TCLP LIMITS FOR METALS	LONG-TERM EFFECTIVENESS / PERMANENCE
Joule-Heated Vitrification	Reduction in mobility of Silo 1&2 COCs demonstrated through laboratory & bench-scale testing of actual and surrogate Silo 1 and 2 material.	Moderate volume reduction	Demonstrated ability to attain TCLP limits with characteristic metals present in Silo 1 and 2 waste	Acceptable long-term effectiveness
Cyclone Vitrification	Reduction in mobility demonstrated through full-scale treatment of similar wastes	Moderate volume reduction	Similar to Joule-heated Vitrification	Acceptable long-term effectiveness
Rotary Vitrification	Reduction in mobility similar to that provided by Joule-heated Vitrification; would require development testing to confirm.	Volume reduction assumed similar to Joule-Heated Vitrification	Similar to Joule-heated Vitrification	Acceptable long-term effectiveness

▭ Basis for exclusion from detailed evaluation

SCREENING OF POTENTIAL TECHNOLOGIES - EFFECTIVENESS

STABILIZATION ALTERNATIVE	MOBILITY OF CONSTITUENTS OF CONCERN	INCREASE/ DECREASE in TREATED WASTE VOLUME[1] Does not consider shielding or packaging volume	ATTAINMENT OF TCLP LIMITS FOR METALS	LONG-TERM EFFECTIVENESS / PERMANENCE
Plasma Arc Vitrification	Reduction in mobility demonstrated through full-scale treatment of similar wastes	Moderate volume reduction	Similar waste streams successfully treated to meet treatment standards for metals	Acceptable long-term effectiveness
Cement-based Chemical Stabilization	Reduction in mobility of Silo 1&2 COCs demonstrated through laboratory & bench-scale testing of actual and surrogate Silo 1 and 2 material.	Modest volume increase shown in Silo 1 and 2 treatability tests	Demonstrated ability to attain TCLP limits with same metals present in Silo 1 and 2 waste	Acceptable long-term effectiveness
non-Cement-based Chemical Stabilization	Reduction through chemical stabilization and physical binding in a solid waste form; demonstrated on similar waste streams	Volume increase should be similar to cement stabilization/solidification	Similar waste streams successfully treated to meet treatment standards for metals	Acceptable long-term effectiveness

☐ Basis for exclusion from detailed evaluation

000014

SCREENING OF POTENTIAL TECHNOLOGIES - EFFECTIVENESS

STABILIZATION ALTERNATIVE	MOBILITY OF CONSTITUENTS OF CONCERN	INCREASE/ DECREASE in TREATED WASTE VOLUME[1] Does not consider shielding or packaging volume	ATTAINMENT OF TCLP LIMITS FOR METALS	LONG-TERM EFFECTIVENESS / PERMANENCE
Ceramic Encapsulation	Mobility reduced through physical binding; no chemical stabilization of contaminants is accomplished	Modest volume reduction provided due to compaction	Not demonstrated; would require development to confirm ability to meet TCLP limits for characteristic metals	Would require development to confirm long-term effectiveness
Polymer Phosphate Stabilization	Reduction through chemical stabilization and physical binding; would require development testing to confirm.	Potential volume increase; should be similar to cement stabilization/solidification	Not demonstrated; would require development to confirm ability to meet TCLP limits for characteristic metals	Would require development to confirm long-term effectiveness
Polymer-based Encapsulation	Mobility reduced through physical binding; no chemical stabilization of contaminants; would require development testing to confirm.	Potential volume increase should be similar to cement stabilization/solidification	Concerns regarding ability to meet TCLP limits for metals when tested in accordance with standard EPA TCLP protocols	Acceptable long-term effectiveness

Basis for exclusion from detailed evaluation

SCREENING OF POTENTIAL TECHNOLOGIES - EFFECTIVENESS

STABILIZATION ALTERNATIVE	MOBILITY OF CONSTITUENTS OF CONCERN	INCREASE/ DECREASE in TREATED WASTE VOLUME[1] Does not consider shielding or packaging volume	ATTAINMENT OF TCLP LIMITS FOR METALS	LONG-TERM EFFECTIVENESS / PERMANENCE
Thermal Stabilization	Mobility reduced through physical binding; would require development testing to confirm.	Potential volume reduction	Not demonstrated; will require development to confirm ability to meet TCLP limits for characteristic metals	Would require development to confirm long-term effectiveness

☐ Basis for exclusion from detailed evaluation

SCREENING OF POTENTIAL TECHNOLOGIES - IMPLEMENTABILITY AND COST

STABILIZATION ALTERNATIVE	COMMERCIAL IMPLEMENTATION	SECONDARY WASTE	PRETREATMENT REQUIREMENTS	PROCESSING THROUGHPUT	RELIABILITY / MAINTAINABILITY	COST
Joule-Heated Vitrification	Used commercially, but limited experience with low-level radioactive wastes at continuous feed rates anticipated for Silo 1 and 2 waste	Complex offgas system increases secondary waste generation	None required	Large processing throughput achievable	Complex facility and equipment requirements. High-temperature operation. Less reliable, more difficult to maintain than other technologies	Complex facility and equipment requirements results in higher capital cost than other stabilization or encapsulation alternatives
Cyclone Vitrification	Used commercially, but limited experience with low-level radioactive wastes at continuous feed rates anticipated for Silo 1 and 2 waste	Complex offgas system increases secondary waste generation	None required	Large processing throughput achievable	Complex facility and equipment requirements. High-temperature operation. Less reliable, more difficult to maintain than other technologies	Complex facility and equipment requirements results in higher capital cost than other stabilization or encapsulation alternatives
Rotary Vitrification	Not demonstrated at full-scale on low level / mixed wastes	Complex offgas system increases secondary waste generation	None required	Not demonstrated at full scale	Complex facility and equipment requirements. High-temperature operation. Less reliable, more difficult to maintain than other technologies	Complex facility and equipment requirements results in higher capital cost than other stabilization or encapsulation alternatives

▭ Basis for exclusion from detailed evaluation

000014

1127

SCREENING OF POTENTIAL TECHNOLOGIES - IMPLEMENTABILITY AND COST

STABILIZATION ALTERNATIVE	COMMERCIAL IMPLEMENTATION	SECONDARY WASTE	PRETREATMENT REQUIREMENTS	PROCESSING THROUGHPUT	RELIABILITY / MAINTAINABILITY	COST
Plasma Arc Vitrification	Demonstrated at full-scale on radionuclide and heavy metal-bearing wastes	Complex offgas system increases secondary waste generation	None required	Not demonstrated at full scale	Complex facility and equipment requirements. High-temperature operation. Less reliable, more difficult to maintain than other technologies	Complex facility and equipment requirements results in higher capital cost than other stabilization or encapsulation alternatives
Cement-based Chemical Stabilization	Used on a commercial basis by numerous vendors	Secondary waste is limited to HEPA filters	Due to high (70% H_2O) moisture content, Silo 1 & 2 waste may require drying/dewatering	Large processing throughput achievable	Facility and equipment requirements are not complex; ambient temperature operation; easily maintained	Moderate cost; packaging, shipping and disposal costs are the predominant factor
non-Cement-based Chemical Stabilization	Commercially demonstrated at full-scale on hazardous (TC metal) waste	Secondary waste is limited to HEPA filters	Due to high (70% H_2O) moisture content, Silo 1 & 2 waste may require drying/dewatering	Large processing throughput achievable	Facility and equipment requirements are not complex; ambient temperature operation; easily maintained	Moderate cost; packaging, transportation and disposal costs are predominant factor

☐ Basis for exclusion from detailed evaluation

000025

SCREENING OF POTENTIAL TECHNOLOGIES - IMPLEMENTABILITY AND COST

STABILIZATION ALTERNATIVE	COMMERCIAL IMPLEMENTATION	SECONDARY WASTE	PRETREATMENT REQUIREMENTS	PROCESSING THROUGHPUT	RELIABILITY / MAINTAINABILITY	COST
Ceramic Encapsulation	Not demonstrated at full-scale on low level / mixed wastes	Volatiles in offgas may require offgas treatment	Due to high (70% H_2O) moisture content, Silo 1 & 2 waste may require drying/dewatering	Not demonstrated at full scale	Facility and equipment requirements are not complex; operating temperature is above-ambient	Cost expected to be similar to other stabilization alternatives; less certain due to lack of full-scale experience as basis for estimate
Polymer Phosphate Stabilization	Not demonstrated at full-scale on low level / mixed wastes	Secondary waste is limited to HEPA filters	Due to high (70% H_2O) moisture content, Silo 1 & 2 waste may require drying/dewatering	Not demonstrated at full scale	Facility and equipment requirements are not complex; ambient temperature operation; easily maintained	Cost expected to be similar to other stabilization alternatives; less certain due to lack of full-scale experience as basis for estimate
Polymer-based Encapsulation	Not demonstrated at full-scale on low level / mixed waste	Volatiles in offgas may require offgas treatment	Requires drying to very low moisture content prior to encapsulation	Not demonstrated at full scale	Facility and equipment requirements are not complex; operating temperature is above-ambient	Cost expected to be similar to other stabilization alternatives; less certain due to lack of full-scale experience as basis for estimate

▭ Basis for exclusion from detailed evaluation

SCREENING OF POTENTIAL TECHNOLOGIES - IMPLEMENTABILITY AND COST

STABILIZATION ALTERNATIVE	COMMERCIAL IMPLEMENTATION	SECONDARY WASTE	PRETREATMENT REQUIREMENTS	PROCESSING THROUGHPUT	RELIABILITY / MAINTAINABILITY	COST
Thermal Stabilization	Not demonstrated at full-scale on low level / mixed wastes	Volatiles in offgas may require offgas treatment	Due to high (70% H_2O) moisture content, Silo 1 & 2 waste may require drying/dewatering	Not demonstrated at full scale	Facility and equipment requirements are more complex than non-thermal stabilization processes; some processes in this category have high operating temperatures, increasing safety concerns	Cost expected to be similar to vitrification alternatives; less certain due to lack of full-scale experience as basis for estimate

Basis for exclusion from detailed evaluation

Silos Project
Proof of Principle - RFP Briefing
Preliminary Screening of Technologies

Technologies To Be Evaluated Through Proof of Principle Testing

- Joule-Heated Vitrification
- Non-Joule-Heated Vitrification

  Includes:

  Cyclone Vitrification
  Plasma-Arc Vitrification

- Chemical Stabilization - Cement-based
- Chemical Stabilization - Ceramic

Silos Project
Proof of Principle - RFP Briefing
Preliminary Screening of Technologies

Technologies Excluded From Additional Evaluation

Technology	Basis For Exclusion
Rotary Vitrification	Not demonstrated at full-scale on low level, hazardous, or mixed wastes.
Ceramic Encapsulation	Not demonstrated at full-scale on low level, hazardous, or mixed wastes.
Polymer Phosphate Stabilization	Not demonstrated at full-scale on low level, hazardous, or mixed wastes.
Polymer-based Encapsulation	Not demonstrated at full-scale on low level, hazardous, or mixed wastes; Concerns regarding ability to meet TCLP limits for metals when tested in accordance with standard EPA TCLP protocols.
Thermal Stabilization	Not demonstrated at full-scale on low level, hazardous, or mixed wastes.

Description of Technologies

Joule-Heated Vitrification

This alternative involves blending the waste with glass forming constituents and applying heat by means of electrodes, to form a stable glass waste form. Constituents such as TC metals are chemically bonded to the glass structure and stabilized into a waste form that is highly resistant to leaching. The high operating temperatures and transformation of the waste into a glass structure results in a treated waste volume less than that of the untreated waste. Although treatment is usually accomplished by heating the waste in a melter, vitrification of wastes which contain sufficient levels of glass forming compounds is sometimes accomplished by applying the heat 'insitu' and retrieving the waste after it has been converted to a glass form. The high temperature operation, as well as offgas treatment requirements (high temperature and moisture content, SO_x) result in relatively complex equipment and operation requirements.

Cyclone Vitrification

In Cyclone Vitrification, untreated waste, glass-forming compounds and fuel are fed to a cyclone-type heater, where rapid heating of the waste and glass-forming compounds occurs. The waste is then converted into a stable glass waste form in a cyclone reactor, accomplishing chemical and physical immobilization of the contaminants of concern. Waste loading, secondary waste generation, offgas treatment requirements, and facility requirements are analogous to those of other vitrification processes.

Rotary Vitrification

Rotary Vitrification accomplishes homogenization, drying and vitrification of the waste stream using a fossil fueled rotary furnace. The furnace operates at very high (up to 1800°C) operating temperatures, potentially utilizing oxygen as a supplemental fuel. The rotary vitrification process is accompanied by complex offgas treatment requirements, and secondary wastes including filters, wastewater, and a solid sludge byproduct requiring treatment through means such as vitrification. Facility and equipment requirements for this process are more complex than most of the other alternatives.

Plasma-Arc Vitrification

Plasma-Arc Vitrification, similar to Joule-heated Vitrification, involves mixing the untreated waste with glass-forming compounds and applying heat to form a waste form with the contaminants chemically and physically immobilized in a glass matrix. This process utilizes a plasma electrode that produces an electric arc that is stabilized on a inert gas stream to supply the necessary heat input. Any organic contaminants present in the waste are converted into constituent elements which are treated in the offgas stream. Again similar to the other vitrification processes, a high-temperature, high-moisture offgas stream containing acid gases, metals and particulates requires a relatively complex offgas treatment system. The offgas treatment requirements and high-temperature operation increase facility and equipment complexity and capital cost compared to non-thermal stabilization alternatives.

Cement-based Chemical Stabilization

Cement stabilization is the most widely used solidification process for low-level mixed waste. The process involves mixing the waste with a variety of cement and chemical additive formulations to accomplish chemical and physical binding of the constituents of concern. Contaminants such as metals are chemically converted to a non-leachable form and physically bound within the cement matrix. It is a non-thermal process with relatively simple facility and equipment requirements.

Non-Cement-based Chemical Stabilization

These technologies are similar to cement-based stabilization processes. Commercial processes exist utilizing a wide variety of additive formulations to accomplish chemical and physical binding of the constituents of concern in a solid matrix. In one commercially-implemented variation of this technology type, chemical reagents are combined with the untreated waste to initiate the formation of species such as barites, apatites, and other crystalline mineral species. Contaminants such as metals are then chemically bonded to minerals within the ceramic-like matrix. As is the case with cement-based stabilization, these processes are low temperature processes with relatively simple facility and equipment requirements.

Ceramic Encapsulation

Ceramic stabilization involves mixing the waste with dry ceramic-forming compounds and heating, usually in an oven, to form a ceramic, or brick-like treated waste form which encapsulates the contaminants. The mobility of constituents of concern is reduced by physically binding the contaminants in the ceramic matrix. As no chemical stabilization is accomplished, prevention of contaminant leaching is dependant solely upon the physical integrity of the waste form. Ceramic stabilization is a high-temperature process with facility and equipment requirements more complex than those of non-thermal stabilization processes. In some variations of this technology-type, compounds such as chemically bonded phosphate ceramics which produce an exothermic chemical reaction are used to provide the necessary heat input without the use of a melter.

Polymer Phosphate Stabilization

In this alternative, chemically bonded phosphate ceramics are used to produce a ceramic waste form without external heating. Contaminants, such as metals, are chemically bound in the ceramic matrix. The production of magnesium phosphate results in an exothermic reaction that provides the heat required to produce the ceramic waste form. Elimination of the requirement for an external heat source simplifies the facility and equipment requirements somewhat compared to other forms of ceramic stabilization.

Polymer-based Encapsulation

This alternative includes a variety of polymer encapsulation processes, such as polyethylene micro encapsulation, sulfur/polymer encapsulation, and ceramic silicon foam encapsulation. All of these processes involve mixing the untreated waste, after drying, with a polymer formulation using means such as a commercial extruder. The mixture is then allowed to solidify, resulting in the contaminants of concern being physically bound in the polymer matrix. Unlike most stabilization processes which convert contaminants to a non-leachable form in addition to physically binding them, polymer encapsulation relies solely on physical isolation of the contaminants to prevent leaching therefore depends solely upon the physical integrity of the treated waste form for its effectiveness. Most encapsulation processes involve higher-than ambient operating temperatures, and require a very dry feed (as low as 1 % moisture). Facility and equipment requirements are somewhat more complex than the chemical or cement-based alternatives.

Thermal Stabilization

This alternative includes several thermal processes involving mixing the untreated waste, at high temperatures, with substances such as molten asphalt, ceramic/aluminum mixture, molten metal, or epoxy resins. The molten mixture is poured into a container and, upon cooling, forms a solid waste form physically binding the contaminants of concern. Many of these processes produce volatile gases requiring offgas treatment. Due to the high-temperature operation and/or offgas treatment requirements, facility and equipment complexity, and capital cost for these processes tend to be higher than those for non-thermal processes.

RECYCLING

Objectives

- Review existing release practices
- Review volumetric release
- Gather stakeholder feedback

RECYCLING

Release of Items Meeting Authorized Limits
An Overview

RECYCLING

What is release?

Release of material from administrative control after confirming the residual radioactive material meets the guidelines of DOE 5400.5.

RECYCLING

What types of materials are released from the site?

All items that enter the Controlled Area must be verified to meet the release criteria prior to exit. For example:

- Approximately 10-15 vehicles are released from the Controlled Area daily
- 834,000 personnel exits from the Controlled Area (based on Personnel Contamination Monitor usage in 1996)
- Approximately 250 tons of scrap metal have been released through the material release facility
- Personal items, hand tools, paperwork, etc, are released daily

RECYCLING

Where do the standards come from?

Regulatory Drivers

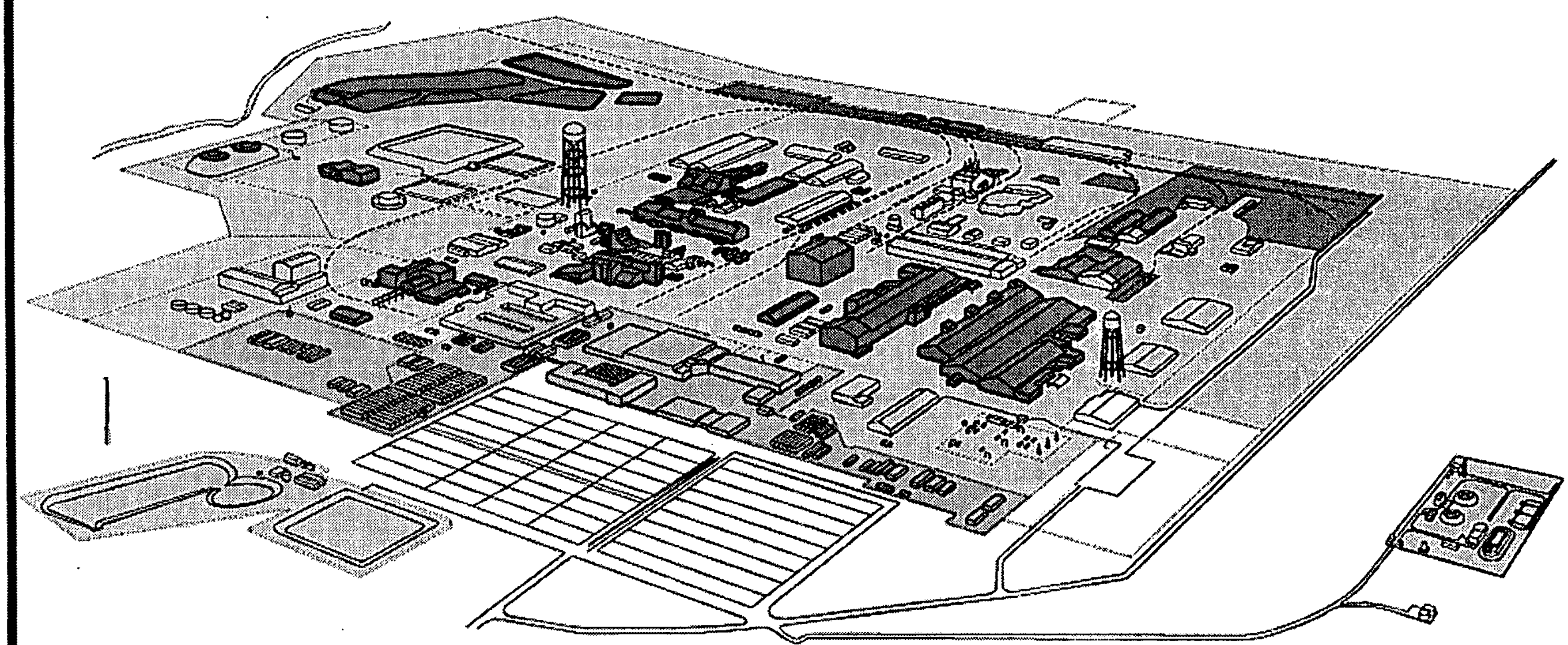
- DOE Order 5400.5, Radiation Protection of the Public and the Environment (will be superseded by 10 CFR 834 when promulgated)
- 10 CFR 835, Occupational Radiation Protection
- DOE Radiological Control Manual

Site Documents

- RM-0020, Radiological Control Requirements Manual
- RP-0009, Radiological Requirements for the Release of Materials at the FEMP

RECYCLING

1996



LEGEND

	ADMINISTRATIVE AREA	
	RADIOLOGICAL CONTROLLED AREA	*Buffer to Radiological Hazard Areas*
	RADIOLOGICAL HAZARD AREA	*Airborne Contamination Radiation Areas*
	REMEDIATED AREA	

RECYCLING

Surface vs. Volumetric Contamination

Surface Contamination

- Refers to radioactive contamination present on the surface of the material
- DOE Order 5400.5 provides authority for release of materials meeting the surface contamination guidelines published in the order
- Items that are potentially contaminated in surfaces that are inaccessible for survey are assumed to exceed the standards for release

RECYCLING

Surface vs. Volumetric Contamination

Volumetric Contamination

- Refers to radioactive material within the material matrix (examples include liquids, bulk compounds, smelted contaminated metals, etc.)

- Materials that are potentially contaminated in depth or volume are generally not released unless it can be shown through a combination of process knowledge, surface contamination data, or analytical data that no radioactivity could have been added to the material as a result of site operations

- DOE Order 5400.5 provides a means for release of material with volumetric contamination based on case-specific development of authorized limits

RECYCLING

What methods are used to verify the standards are met?

A combination of tools are used to verify materials meet standards prior to release, including:

- Surface contamination surveys by Radiological Control Technicians
- Historical knowledge of the material to determine types and extent of surveys required

RECYCLING

Authorized Limits for Fernald Copper Ingots

- "Authorized limits" defined
- History of Fernald copper ingots
- Steps in developing authorized limits
- Results from authorized limits analyses
- Stakeholder coordination efforts
- Implementing release

RECYCLING

"Authorized Limits"

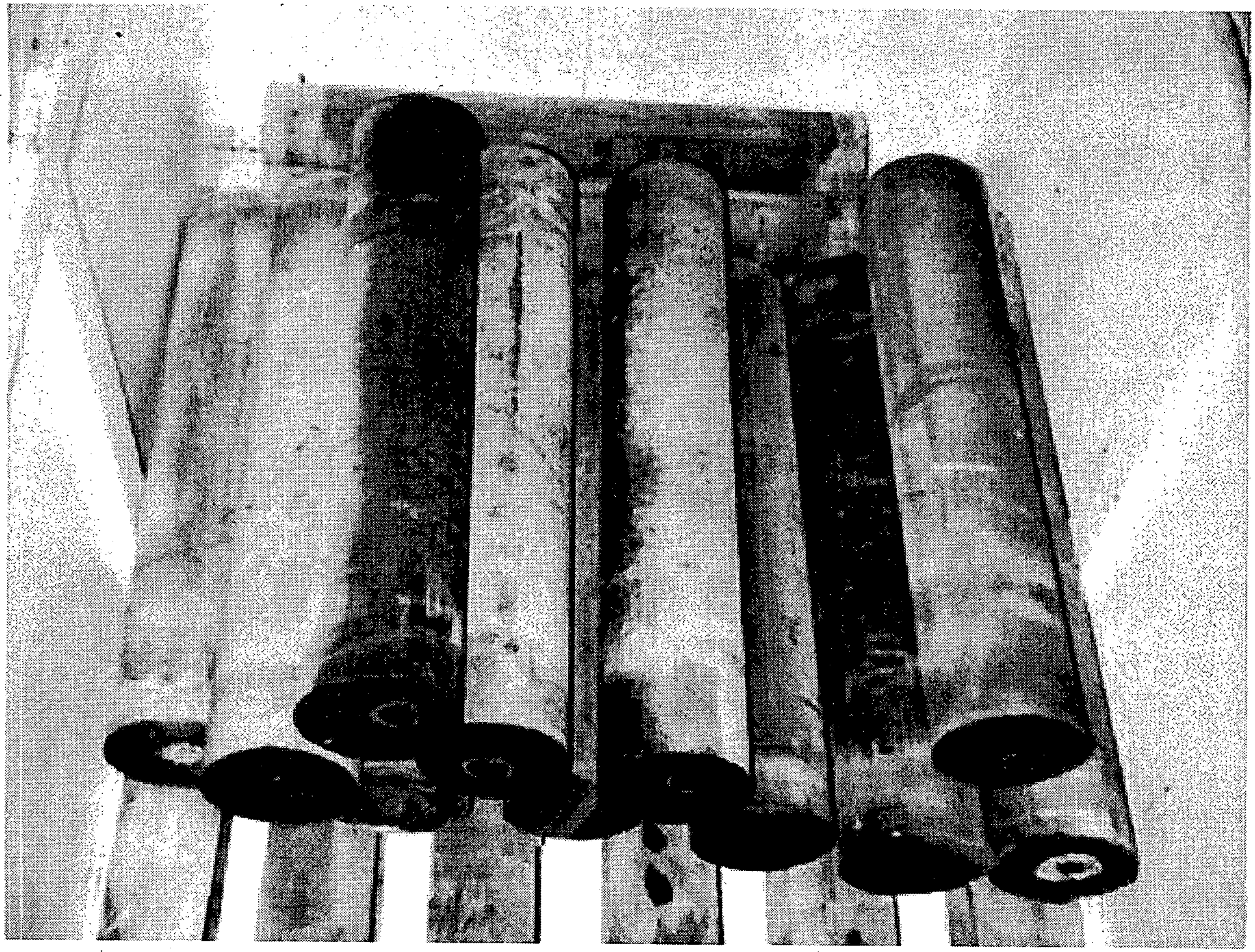
- Alternative approach for release
- Requires case-specific analysis
- Risk-based approach using pathway analysis
  - Maximum exposure to individual ~ 1 mrem/yr
  - Collective dose < 10 person-rem
- Stakeholder coordination important
- Approval on case-by-case basis

RECYCLING

History of Fernald Copper Ingots

- Melt-refined from Gaseous Diffusion Plant motor windings
- Cast into ingots for recycle
  - 240,000 pounds into ~ 500 ingots
  - 7-8 inch diameter, 30 inches long
  - 1.6 ppm uranium, up to 1.81% ^{235}U
- Rad and chemical analyses for each ingot
- 230 to Hanford; 270 ingots left

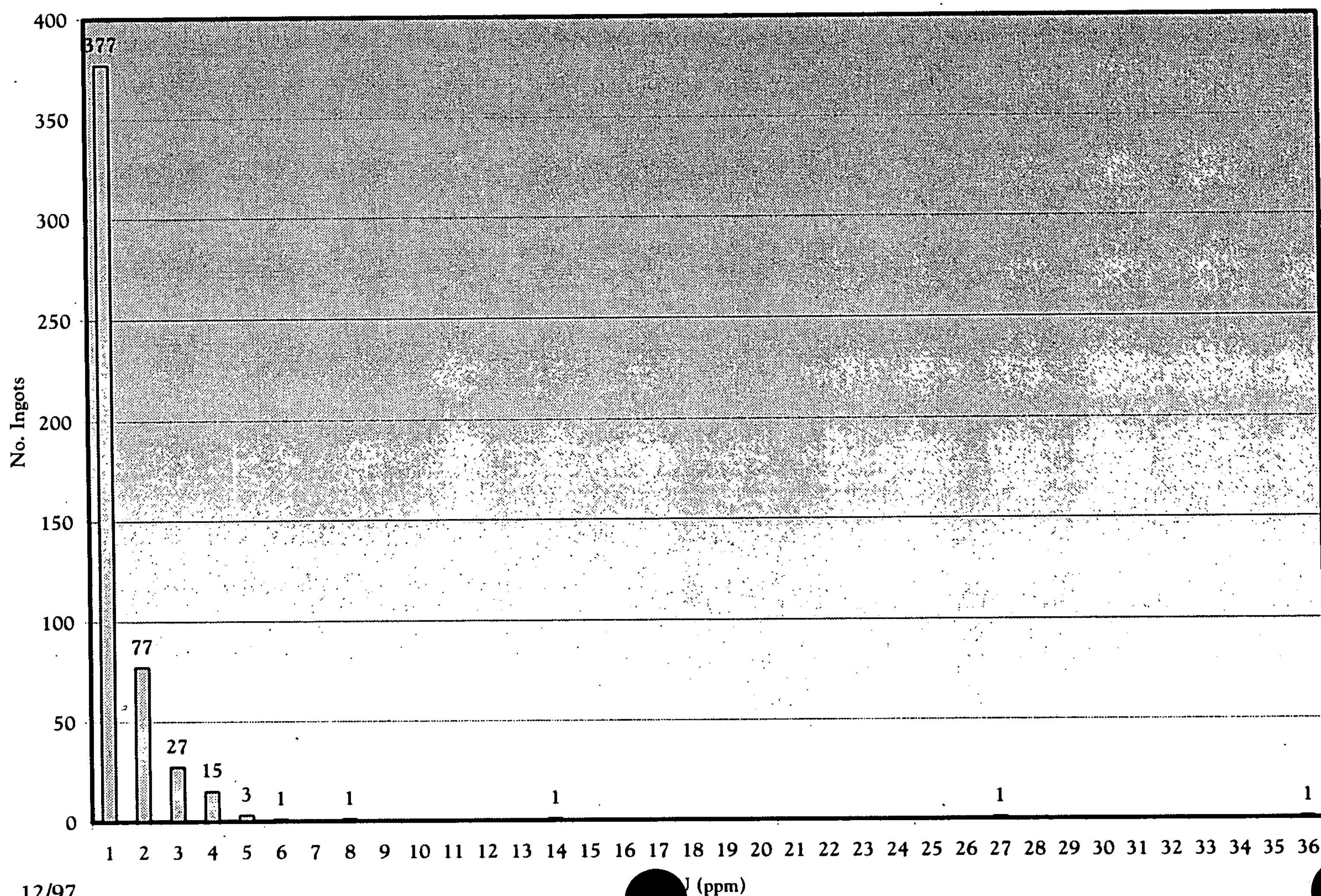
INGOTS IN STORAGE AT FERNALD



4847.B13 Photo #6743-1 12/97

RECYCLING

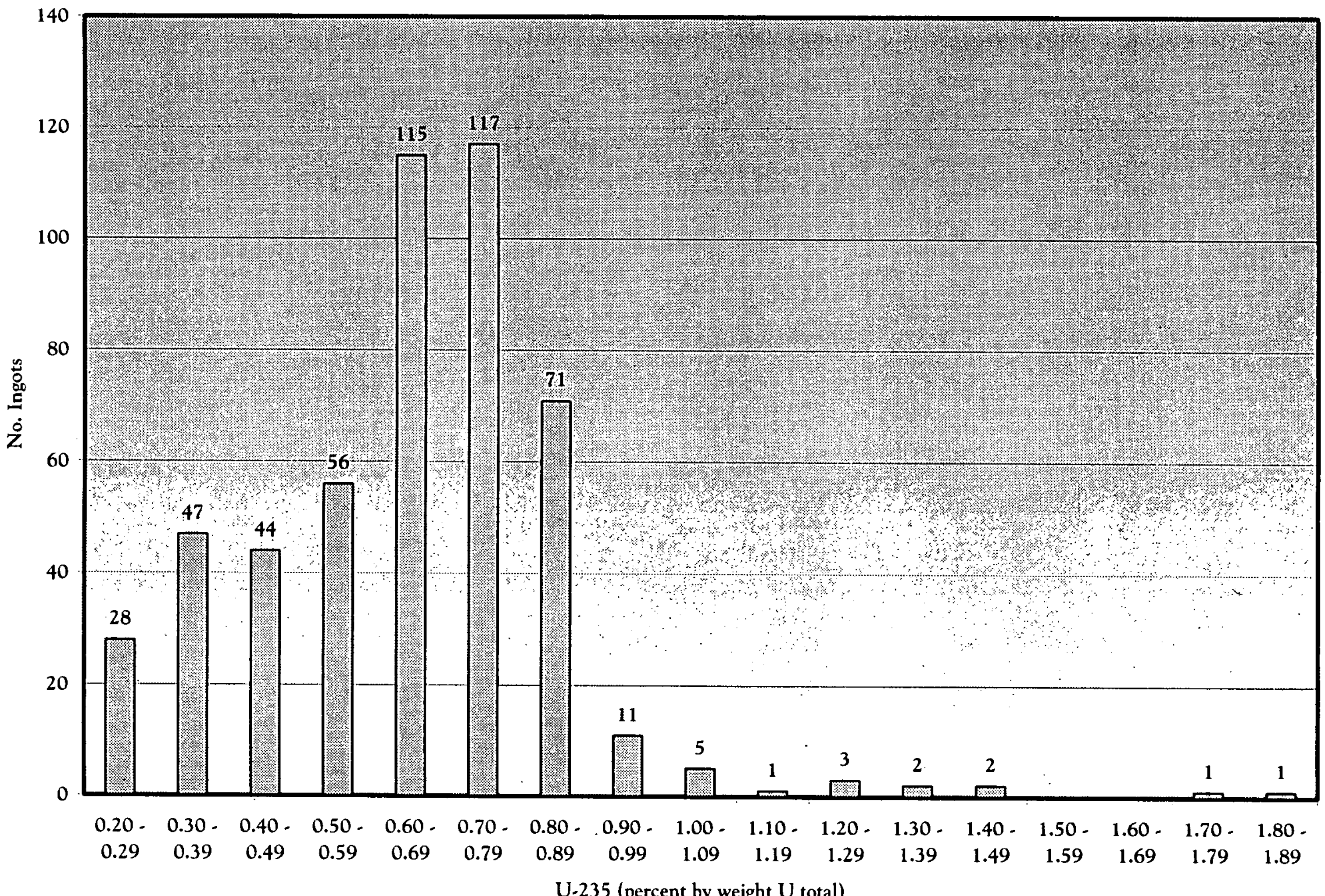
Fernald Copper Ingots
Total U Distribution



000036

RECYCLING

Fernald Copper Ingots Enrichment Distribution



4847.B15 12/97

000037

RECYCLING

Steps in Developing Authorized Limits

- Description of copper ingots
- Disposition alternatives
- Dose assessment
- Cost analysis
- As Low As Reasonably Achievable (ALARA) analysis
- Additional factors
- Stakeholder coordination
- Preparation prior to release
- Verifying compliance with limits

RECYCLING

Products Modeled

Modeled Product	Probability of Use
building wire	15%
plumbing tube	8%
plumbing hardware	6%
jewelry bracelet	<1%
frying pan	<1%
musical instrument	<1%
sterling flatware	<1%
copper T-380 IUD	<1%

Recycling

Modeled Exposures

Exposure	Individual Dose (mrem/yr)	Cumulative Dose (person-rem)
Slag worker	0.0177	0.000018
Scrap loader	0.0013	0.000002
Plumbing tube	0.0007	0.031
Frying pan	0.0005	0.011
Copper IUD	0.0001	0.043

RECYCLING

Cost and ALARA Analysis

- Cost analysis
  - Unrestricted recycle returns $56K
  - Disposal at the Nevada Test Site costs $42K
  - On-site disposal somewhere in between
- ALARA analysis
  - Modeled exposures very low
  - No cost effective means to further reduce

RECYCLING

Additional Factors

- Decision methodology framework
- Constructed scales addressing:
  - Schedule impacts
  - Local economic impacts
  - Institutional preference
  - Local social preference
  - Environmental impacts
- Recycle dominated disposal alternative

RECYCLING

Stakeholder Coordination

- Public participation
  - Workshops on Decision Methodology
  - Fact sheet on copper project
  - Follow up on questions raised
- Institutional stakeholders
  - Input from OEPA and USEPA
  - Coordination with Nuclear Regulatory Commission and Ohio Department of Health
  - Approval through DOE

RECYCLING

Release Implementation

- Conduct surface decontamination/survey
- Verify compliance with authorized limits
- Apply property management procedures
- Notify bidders of rad/chemical content
- Sale of copper to secondary copper industry
- Reinvest proceeds from sale at Fernald

RECYCLING

Objectives

- Review existing release practices
- Review volumetric release
- Gather stakeholder feedback

RECYCLING

Authorized Limits for Fernald Copper Ingots

- Protection of Human Health
  - Dose to maximally exposed individual (MEI) <0.02 mrem/yr
  - Excess cancer risk to MEI less than 1 in 100,000,000
- Protective of Environment
  - Reduce impacts of mining copper ore
  - Incrementally reduces waste disposal from Fernald
- Cost Effective
  - Results in net revenue to DOE (~ $50,000)

RECYCLING

Stakeholder Coordination

Stakeholder coordination is required as part of the authorized limits process

Are there any stakeholder issues or questions that DOE should consider before proceeding?

SILOS PROJECT

- Silos 1 and 2 Proof of Principles Project:
  - Proof of Principle contract award - August 10, 1998 (enforceable milestone)
- Silos 1 and 2 Accelerated Waste Retrieval Project:
  - Critical Analysis - December 9 - 11, 1997
- Silo 3 Project:
  - Explanation of Significant Differences - comment period ends December 16, 1997
  - Concluded public input / comments on the Draft Request for Proposal - December 3, 1997

SILOS PROJECT

Focus on Public Involvement

- Silo 3 Remediation Project
- Silos 1 and 2 Revised Feasibility Study / Proposed Plan
- Silos 1 and 2 Early Waste Retrieval Evaluation

SILOS PROJECT

Silo 3 Remediation Project
Focus on Public Involvement

- Finalization of Explanation of Significant Difference (ESD)
  - Public comment period ends December 16, 1997
  - All comments to be addressed in Responsiveness Summary
  - Final ESD expected January 1998
- Finalization of Silo 3 Request for Proposal
  - Public / Vendor review period ended December 3, 1997
  - Summary of comments received and proposed finalization of Request for Proposal to be presented publicly in Mid-January
  - Finalize Request for Proposal following resolution of comments on the draft document - March 1998

SILOS PROJECT

Silos 1 and 2 Revised Feasibility Study / Proposed Plan Focus on Public Involvement

- Preliminary screening of technologies
  - Presented for public discussion December 9, 1997
- Silos 1 and 2 Proof of Principle Testing
  - Public overview of Request for Proposal contents - December 9, 1997
  - Request for Proposal Briefing Package and Statement of Work available for public inspection through Mid-January
  - Public forum in mid-January to receive / resolve public feedback
  - Issue Request for Proposal - April 1998
- Periodic public status reviews

SILOS PROJECT

Silos 1 and 2 Early Waste Retrieval Evaluation Focus on Public Involvement

- Critical Analysis - December 9 - 11, 1997
- Issue Commerce Business Daily announcement - December 1997
- Discuss Critical Analysis results - January Cleanup Progress Briefing
- Issue Final Request for Proposal - Spring 1998

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE
Request for Proposal Briefing
Introduction

What is Proof of Principle Testing?

- A large-scale (1 ton of treated waste / day) test designed to obtain reliable quantitative data for technologies that are technically feasible and commercially available

- Proof of Principle testing will provide: pre-conceptual engineering; cost estimates; and scheduling to support detailed analysis of alternatives

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE
Request for Proposal Briefing
Introduction

Why perform Proof of Principle testing?

- Actual commercial data is required to ensure a high quality, comprehensive evaluation of alternatives in the Feasibility Study

- Specially required by the Settlement Document in regard to the "Dispute Concerning Denial of Request for Extension of Time for Certain Operable Unit 4 Milestones."

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE

Proof of Principle Data Requirements	Protectiveness	Comply with ARARs	Long-Term Effectiveness	Reduction of Volume	Short-Term Effectiveness	Implement-ability	Cost
Perform Lab-Scale Testing	X	X	X	X	X		
Determine Pre-Treatment Requirements						X	X
Perform Large-Scale Testing						X	X
Determine Treated Waste Characteristics - Compressive Strength - No Free Liquids - TCLP Metals - Particulate - RCRA Characteristics	X	X	X	X	X	X	X
Waste Loading				X	X		X
Bulking Factor				X			X
Down Time						X	X
Secondary Waste						X	X
Off gas Composition						X	X
Projected Costs - Equipment - Buildings - Operations - Energy - Additives							X
Design Data - General Arrangement - Process Flow Diagram - Equipment List - Mass Balance - Radon Control Strategy						X	X
Process Hazards and Mitigators					X	X	X
Process Challenges						X	X

1127

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE
Request for Proposal Briefing
Technologies To Be Considered

Technologies	Source of Technologies		
	IRT	Silo 3 ESD	CBD
Joule-Heated Vitrification	X		X
Cyclone Vitrification			X
Rotary Vitrification			X
Plasma Arc Vitrification			X
Cement-based Stabilization	X	X	X
Ceramic Encapsulation	X	X	X
Polymer Phosphate Stabilization			X
Chemical Stabilization (non cement-based)	X	X	X
Polymer-Based Encapsulation	X	X	X
Thermal Stabilization	X	X	

000056

4847.C12 12/97

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE
Request for Proposal Briefing
CBD Response

Vitrification

GTS Duratek
ToxGon Corporation
BNFL Inc.
Vortec Corporation
Battelle Pacific Northwest Division
Envitco
Nukem Nuclear Technologies
MGC Plasma AG
Allied Technology Group
Foster Wheeler Environmental Corp

Chemical Stabilization

GTS Duratek
Chem-Nuclear Systems
BNFL Inc.
Coleman Energy & Environment
Surface Technology Systems
Allied Technology Group
International Technology Corporation
Envirocare of Utah Inc.
Foster Wheeler Environmental Corporation
Sevenson Environmental Services Inc.
Perma-Fix Environmental Services
Molten Metal Technology
Nukem Nuclear Technologies
OHM Remediation Services Group
Starmet Aerocast
Crowe Technologies LLC

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE
Request for Proposal Briefing
Preliminary Screening

Effectiveness

- Mobility of Constituents of Concern
- Increase / Decrease in Treated Waste Volume
- Attainment of TCLP limits for Characteristic Metals
- Long-Term Effectiveness / Permanence

Silos Project
Silos 1&2 Proof Of Principle
Request for Proposal Briefing
Preliminary Screening
(Continued)

Implementability

- Degree of Commercial Implementation
- Generation of Secondary Waste Streams
- Pretreatment Requirements
- Processing Throughput
- System Reliability / Maintainability

Cost

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE
Request for Proposal Briefing
Technology Families

Interested vendors will be grouped into four technology families including:

- Vitrification - Joule-heated
- Vitrification - Cyclone Vitrification
Plasma-Arc Vitrification
- Chemical Stabilization - Cement
- Chemical Stabilization - Ceramic

Vendors will be evaluated and one contract will be awarded in each family

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE
Request for Proposal Briefing
Evaluation Criteria and Standards -
Initial Pass/Fail Criteria

Vendors must:

- Possess acceptable safety record
- Utilize a laboratory on Fernald's approved list to generate reliable analytical data
- Comply with all specified project milestones
- Vendor proposal's will be evaluated based on cost and technical merit

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE
Request for Proposal Briefing
Evaluation Criteria and Standards

Criterion 1 - Relevant Experience

- Vendor's proposed process must have been used to successfully treat either:
  - low-level radiological waste,
  - mixed waste, or
  - hazardous waste
- Emphasis on treating waste w/ concentrations of lead and barium compounds
- Vendor's process must produce a waste form that is acceptable for final disposal
- Vendor must have successfully performed at least one remediation project within the last five years that had a duration of one year or more

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE
Request for Proposal Briefing
Evaluation Criteria and Standards
(Continued)

Criterion 2 - Description of Proof of Principle Testing Method

Vendor must provide a complete description of Proof of Principle Testing; including:

- Complete description of test facilities, location and testing methods
- Equipment type, size (scale), application, and arrangement
- Physical and chemical properties of treatment process
- Basis for confidence of successful treatment
- Effectiveness of hazardous constituents treatment

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE

Request for Proposal Briefing
Evaluation Criteria and Standards
(Continued)

<u>Criterion 2 - Description of Proof Of Principle Testing Method</u>

- Waste loading / bulking factors
- Processing and chemical challenges and how they will be addressed
- Secondary waste streams, volumes and treatment method
- Process hazards and safety issues and proposed mitigators
- Radon control processes for both in process and treated waste

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE
Request for Proposal Briefing
Evaluation Criteria and Standards
(Continued)

<u>Criterion 3 - Description of Proof of Principle Testing Scale</u>

Vendor must provide evidence that the proposed technology will meet the production rate requirements

<u>Criterion 4 - Key Personnel for Proof of Principle Testing</u>

Vendor must provide information that key personnel have relevant past project experience treating waste streams similar to Silos 1 and 2 residues

<u>Criterion 5 - Quality Assurance (QA) Program for the Proof of Principle</u>

Vendor must provide a description of the QA Program to be used for testing

SILOS PROJECT
SILOS 1&2 PROOF OF PRINCIPLE
Request for Proposal Briefing
Path Forward

- Commerce Business Daily notice issued on September 25, 1997
- Public briefing - December 9, 1997
- Public comments and / or concerns to be addressed at January 13, 1998 Cleanup Progress Briefing
- Issue Request for Proposal by April 14, 1998
- Award Request for Proposal by August 10, 1998
- Ongoing updates on the status of the project will be provided at monthly Cleanup Progress Briefings